Internationa

N93-27000

0163207

Unclas

CHEMICAL ANALYSES Report OF PROVIDED SAMPLES Final Corp. (SRI International (NASA-CR-193207)

REPORT ON CHEMICAL ANALYSES OF PROVIDED SAMPLES

Christopher H. Becker Molecular Physics Laboratory

SRI Project 3557 Contract No. 1-1EH-46755

MP 93-084

Prepared for:

NASA Marshall Space Flight Center Huntsville, AL 35812

Attn: Roger Linton Mail Stop EH15

Approved:

Donald J. Eckstrom, Director Molecular Physics Laboratory

Final Report - April 1993

REPORT D	Form Approved OMB No. 0704-0188							
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gethering and maintaining the data needed, and semplating and reviewing the optication of information including suggestions for reducing this burden separation this burden service and respect of this selection of information, including suggestions for reducing this burden, to Washington Headquerters Sentions, Directorates for Information Operations and Reports, 1215 Jefferson Davis Highwey, Suite 1204, Artifigron, VA 22202-4502, and to the Office of Management and Budget Pers Paperwork Reduction Project (0704-0188), Weehington, DC 20603.								
Davis Highway, Suite 1204, Arlington, VA 22202- 1. AGENCY USE ONLY (Leave blank)	(ank) 2. REPORT DATE 3. REPORT TYPE AND DATE							
April 1993 Final Report 4. TITLE AND SUBTITLE REPORT ON CHEMICAL ANALYSES OF PROVIDED SAMPLES			5. FUNDING NUMBERS					
6. AUTHOR(S) Christopher H. Becker	:							
7. PERFORMING ORGANIZATION N SRI International 333 Ravenswood Avenue Menlo Park, CA 9402		8. PERFORMING ORGANIZATION REPORT NUMBER PYU 3557 MP 93-084						
9. SPONSORING/MONITORING AG NASA Marshall Space Huntsville, AL 3581	5)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER						
11. SUPPLEMENTARY NOTES 12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited				12b. DISTRIBUTION CODE				
A batch of four samples were received and chemical analysis was performed of the surface and near surface regions of the samples by the surface analysis by laser ionization (SALI) method. The samples included four one-inch diameter optics labeled windows # PR14 and PR17 and MgF2 mirrors 9-93 PPPC exp. and control DMES 26-92. The analyses emphasized surface contamination or modification. In these studies, pulsed desorption by 355 nm laser light and single-photon ionization (SPI) above the sample by coherent 118 nm radiation (at ~5 x 105 W/cm2) were used, emphasizing organic analysis. For the two windows with an apparent yellowish contaminant film, higher desorption laser power was needed to provide substantial signals, indicating a less volatile contamination than for the two mirrors. Window PR14 and the 9-93 mirror showed more hydrocarbon components than the other two samples. The mass spectra, which show considerable complexity, are discussed in terms of various potential								
14. SUBJECT TERMS EDEF, surface analy space environmental		NUMBER OF PAGES 17 PRICE CODE						
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFIC OF ABSTRACT Unclassified		LIMITATION OF ABSTRACT UL				

A batch of four samples was received consisting of one inch diameter optics labeled windows # PR14 and PR17, and MgF2 mirrors 9-93 PPPC exp. and control DMES 26-92. Chemical analyses of the surfaces were performed by the surface analysis by laser ionization (SALI) method. The analyses emphasize surface contamination. SALI uses nonselective photoionization of sputtered or desorbed atoms and molecules above but close (~1 mm) to the surface, followed by time-of-flight (TOF) mass spectrometry. In these studies, laser-induced desorption by 5 ns pulse-width 355 nm light (10-100 mJ/cm2) and single-photon ionization (SPI) by coherent 118 nm radiation (at ~5 × 10⁵ W/cm²) were used. SPI was chosen primarily for its ability to obtain molecular information, whereas multiphoton ionization (not used in the present studies) is intended primarily for elemental and small molecule information. The choice of laser desorption was made after initial studies with pulsed Ar+ sputtering; it was apparent that considerably more dynamic range and higher mass range were available with laser desorption; also charging of the optics was occurring with the pulsed Ar+ beam.

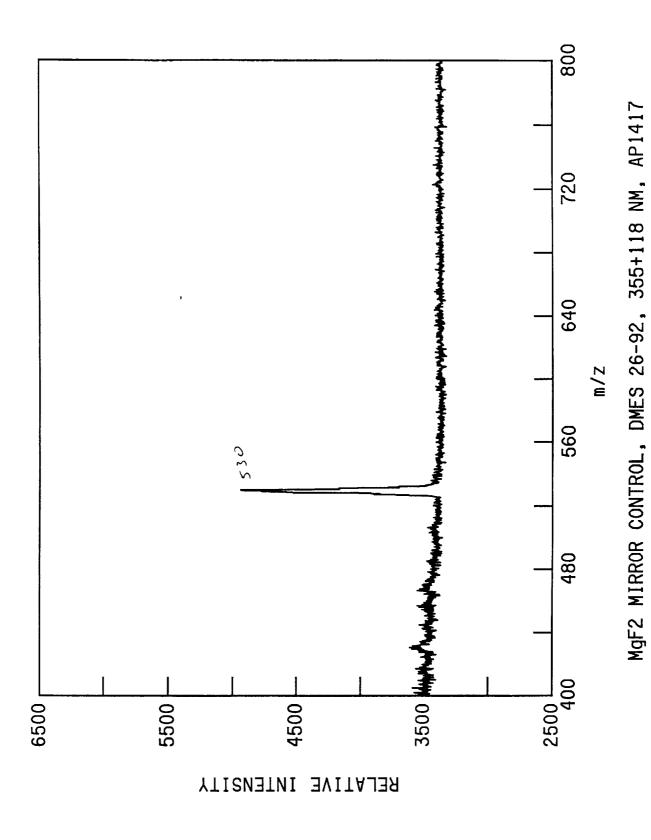
While SPI by 118 nm (10.5 eV) light is considered a generally "soft" (nonfragmenting) form of radiation, stimulated desorption can cause fragmentation and also produce internally hot molecules which photofragment relatively easily compared to lower temperature sources of molecules. Typically, the low mass regions of the mass spectra contain a good deal of molecular fragment information.

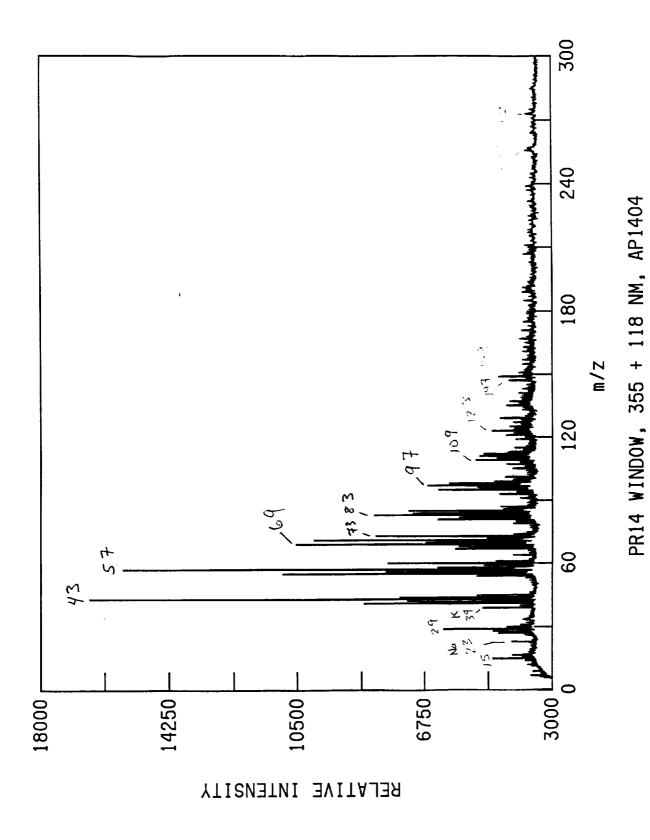
Some other comments on the mass spectra are appropriate. The signals from the microchannel plate detector were recorded in analog fashion by a 100 MHz transient digitizer; thus the voltage signals are given as "relative intensity" and not as ion counts. For the two windows with apparent yellowish contaminant films (PR14 and 17), higher desorption laser intensities were needed to provide substantial signals, indicating a less volatile contamination than for the two mirrors (or possibly poorer absorptivity of 355 nm light). For sample PR17, and a little bit for the control mirror (DMES 26-92), direct ion signals (intense and broad mass peaks on a different mass scale--different time zero) are seen in the low mass region.

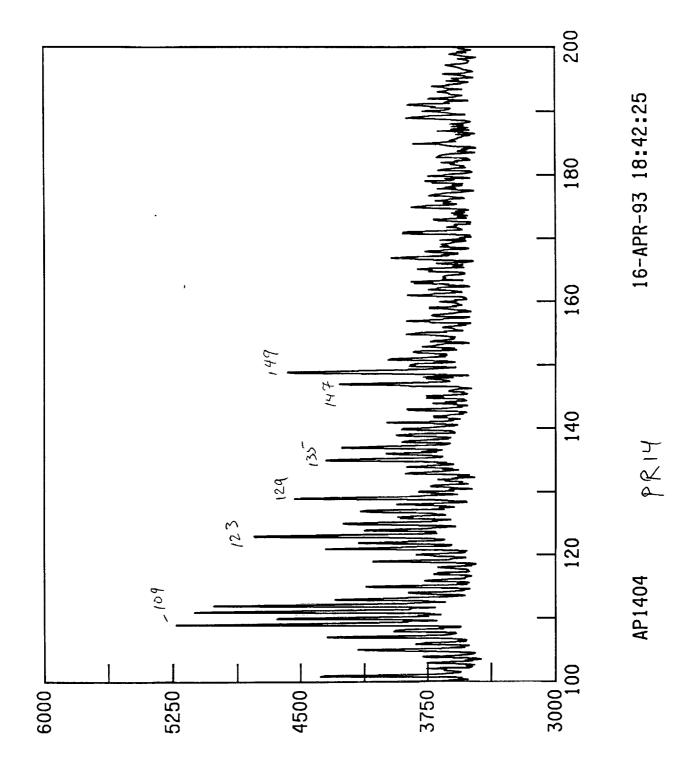
Some of the mass assignments have been marked on the figures, especially for the major peaks. Considerable effort can be invoked for mass interpretation. Some possible brief general interpretations now follow. Window PR14 and the 9-93 MgF2 mirror show considerably more hydrocarbon fragments at low masses and thus likely contain much more hydrocarbon components than the other two samples.

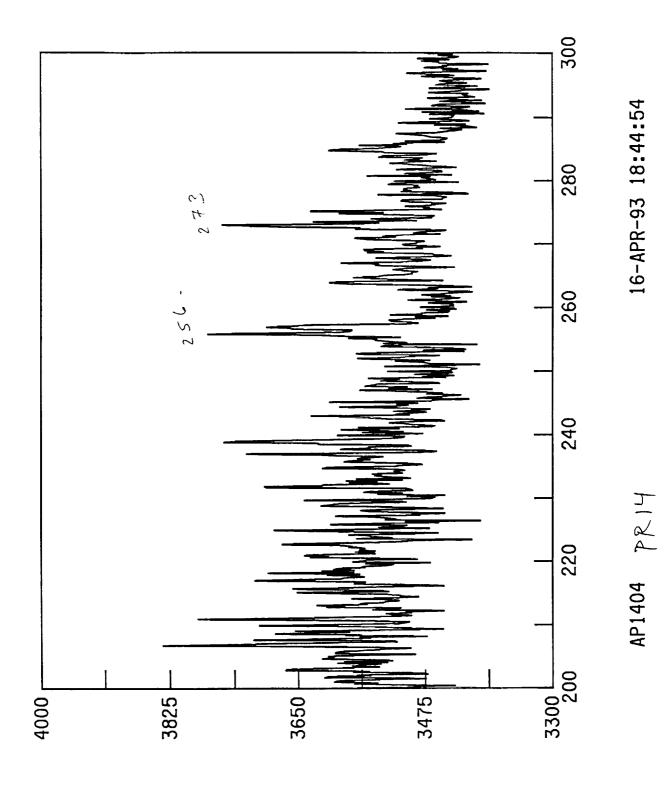
For PR17 the m/z 105 and 207 peaks can be associated with Si and O (Si2O3H for 105 and Si3O3(CH3)5 for 207), although there are other interpretations such as C6H5-CO for m/z 105. Also it would be unusual to observe a strong 207 and not a strong 73 or 147 for a silicone. Polydimethylsilicone was run as a standard for comparison under these conditions; strong peaks at m/z 73, 147, 207, 221, and 281 were observed.

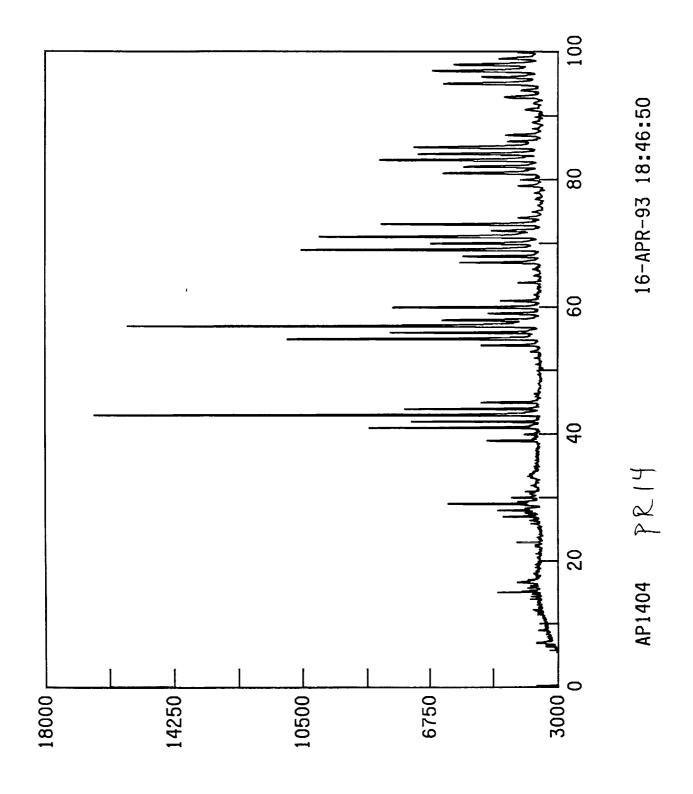
For the two MgF2 mirrors, there are numerous major mass peaks in common such as 43, 57, 97, 112, 149, 167. 185 and 221. Note that 221 can possibly be assigned to a silicone, but the other peaks are not commonly associated with silicones except m/z 129 in the 9-93 mirror which can be rationalized as a Si2C5H13 structure. Masses 97, 112, 149, 167, and 185 can be assigned to CxFyOz structures. As to the higher mass assignments for the control mirror, it is not clear (especially with no detailed knowledge of sample history) what structures are associated with these masses; however, these peaks will be very characteristic of whatever compound(s) is present.

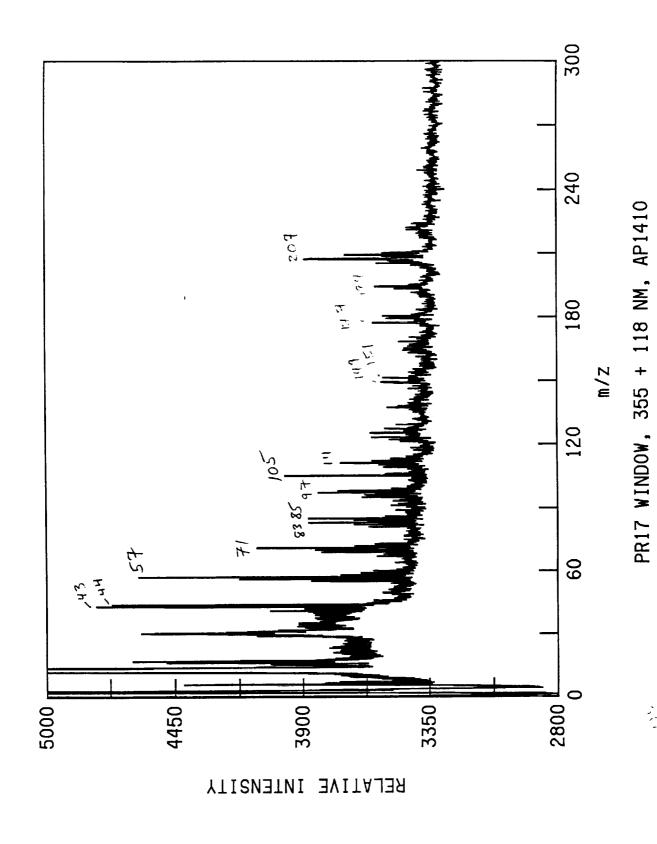


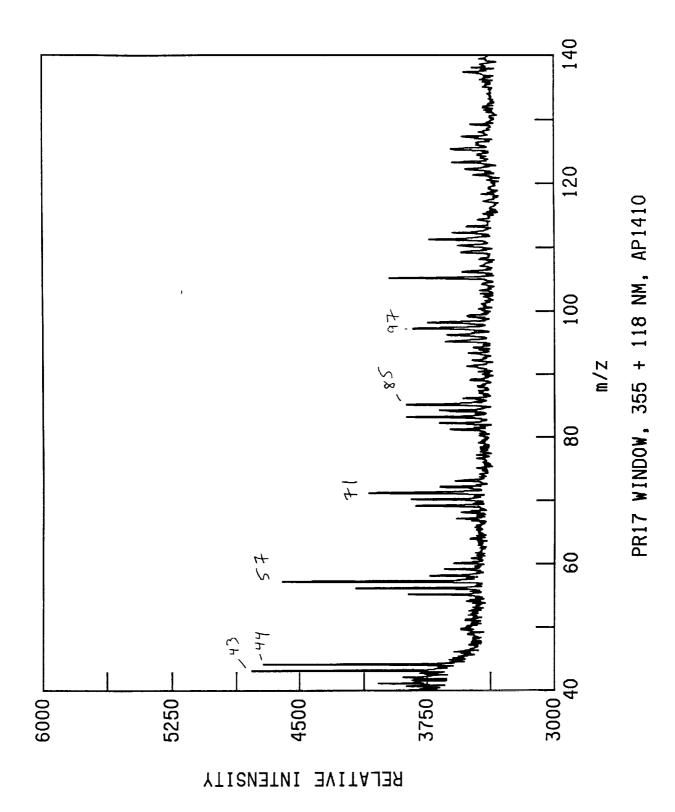


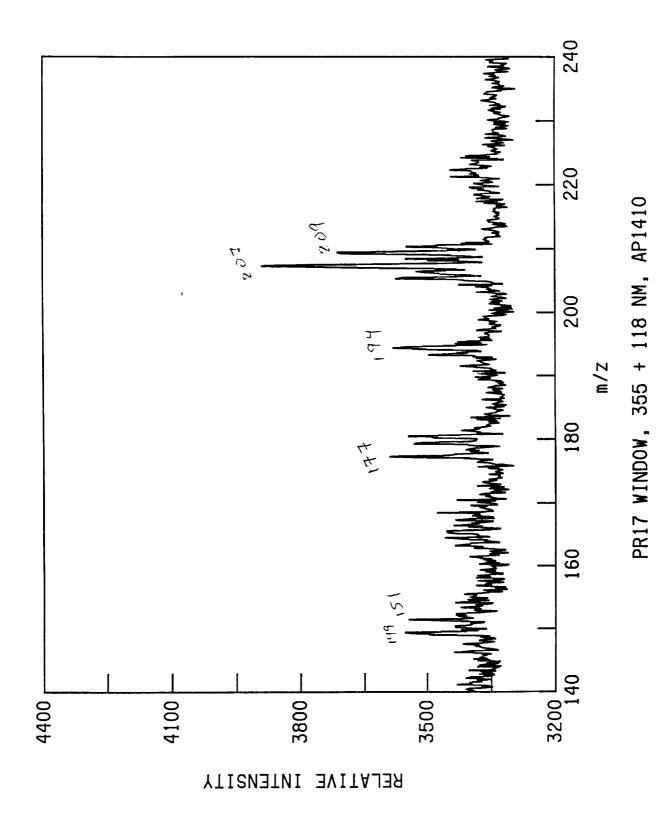


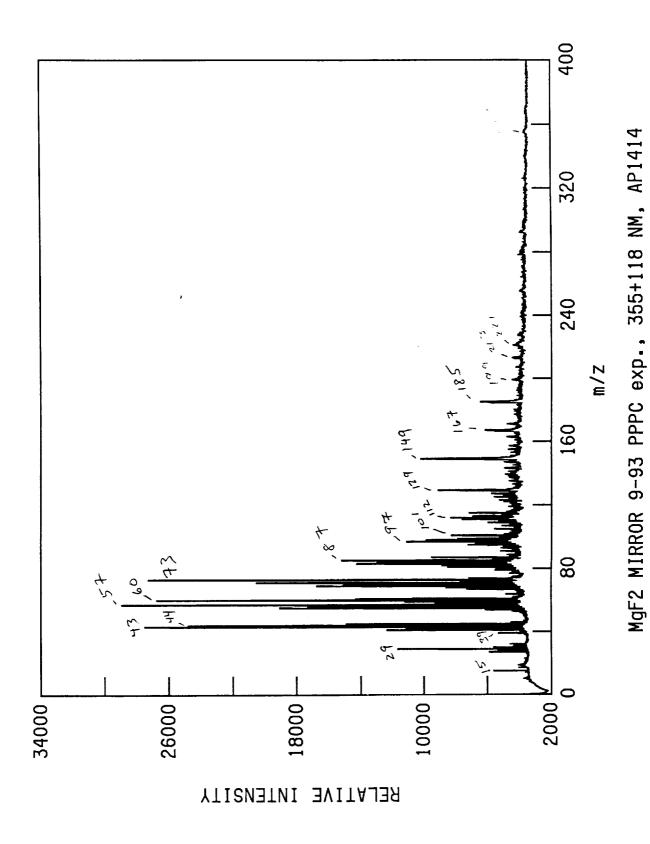


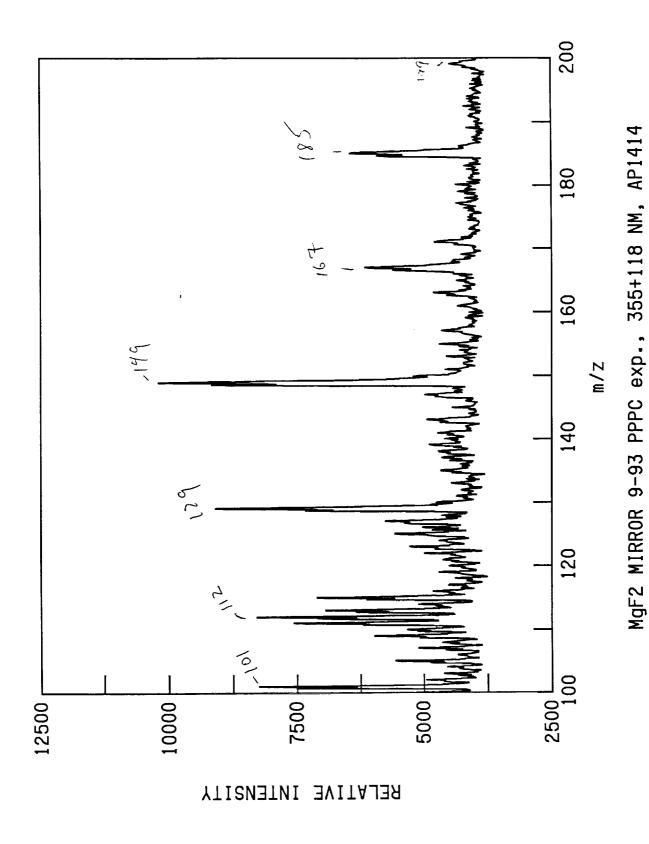


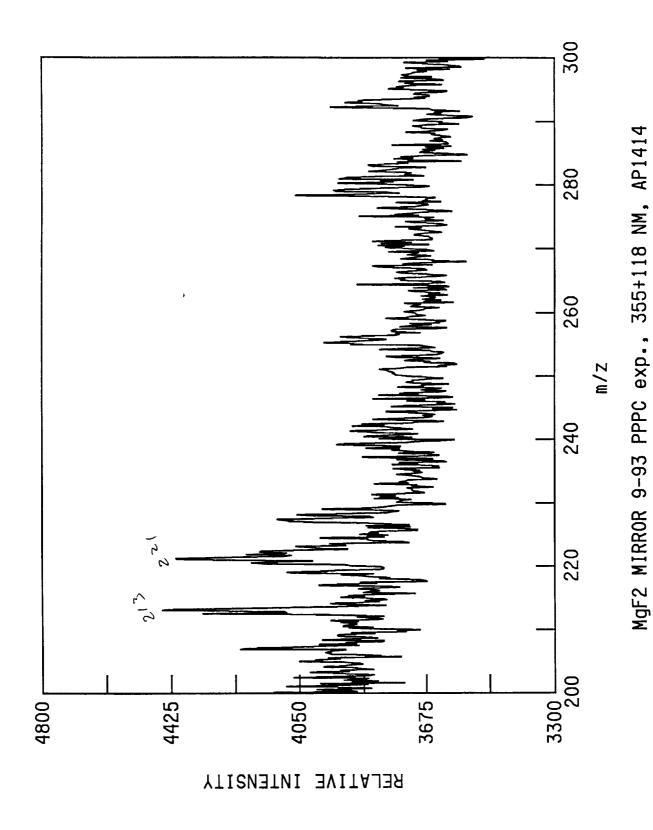


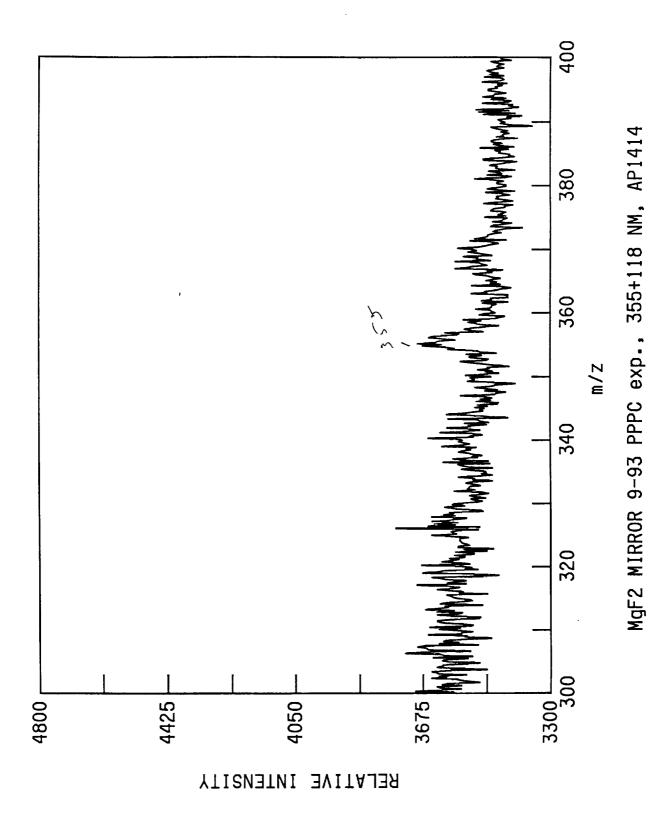


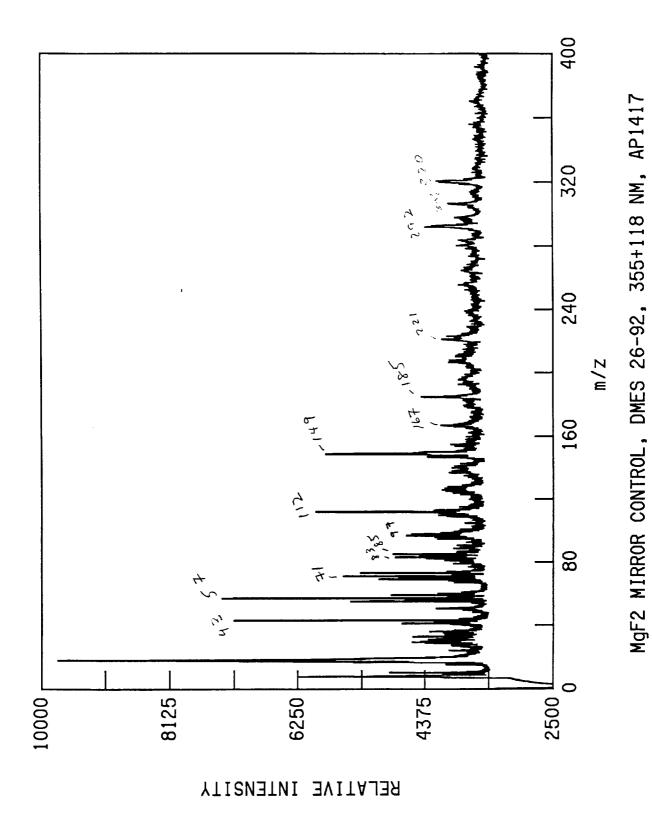


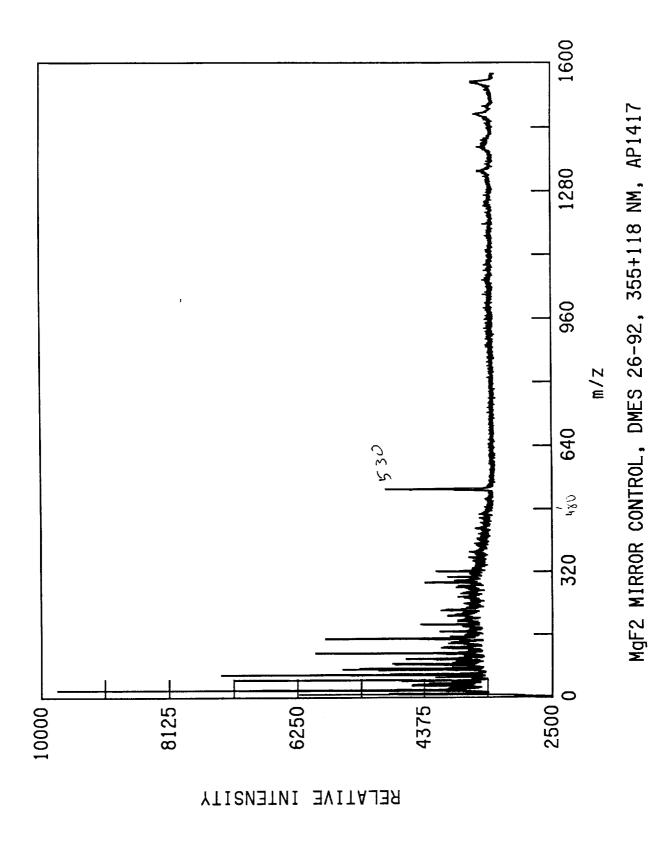


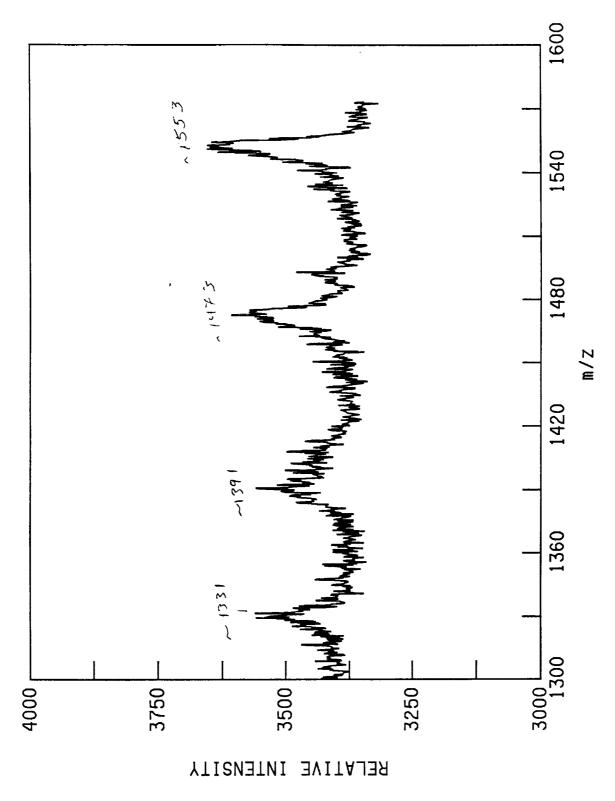












MgF2 MIRROR CONTROL, DMES 26-92, 355+118 NM, AP1417

NASA-CR-196593

SRI International

N93-27000

Final Report • April 1993

REPORT ON CHEMICAL ANALYSES OF PROVIDED SAMPLES

Christopher H. Becker Molecular Physics Laboratory

SRI Project 3557 Contract No. 1-1EH-46755

MP 93-084

Prepared for:

NASA Marshall Space Flight Center Huntsville, AL 35812

Attn: Roger Linton Mail Stop EH15

Approved:

Donald J. Eckstrom, Director Molecular Physics Laboratory A batch of four samples was received consisting of one inch diameter optics labeled windows # PR14 and PR17, and MgF2 mirrors 9-93 PPPC exp. and control DMES 26-92. Chemical analyses of the surfaces were performed by the surface analysis by laser ionization (SALI) method. The analyses emphasize surface contamination. SALI uses nonselective photoionization of sputtered or desorbed atoms and molecules above but close (\sim 1 mm) to the surface, followed by time-of-flight (TOF) mass spectrometry. In these studies, laser-induced desorption by 5 ns pulse-width 355 nm light (10-100 mJ/cm2) and single-photon ionization (SPI) by coherent 118 nm radiation (at \sim 5 × 10⁵ W/cm²) were used. SPI was chosen primarily for its ability to obtain molecular information, whereas multiphoton ionization (not used in the present studies) is intended primarily for elemental and small molecule information. The choice of laser desorption was made after initial studies with pulsed Ar+ sputtering; it was apparent that considerably more dynamic range and higher mass range were available with laser desorption; also charging of the optics was occurring with the pulsed Ar+ beam.

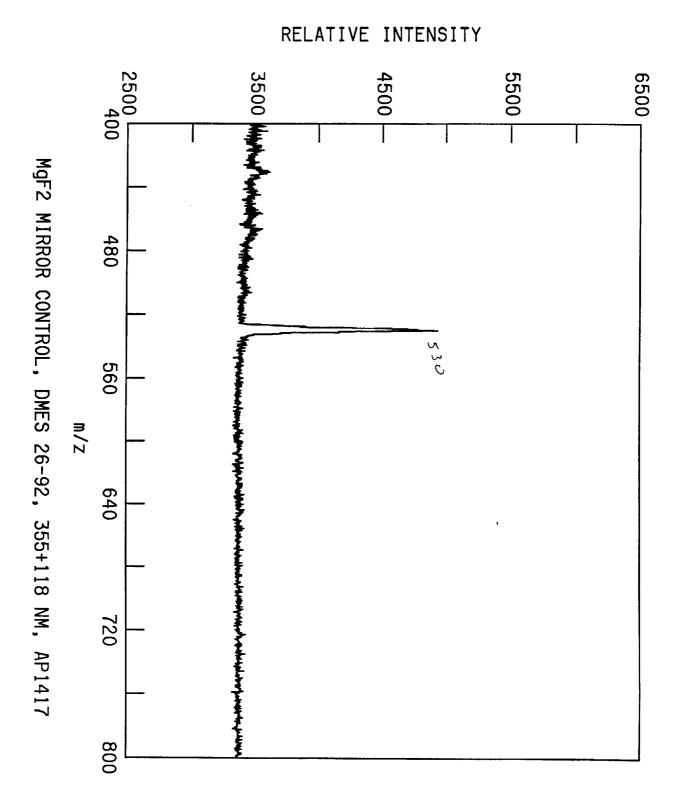
While SPI by 118 nm (10.5 eV) light is considered a generally "soft" (nonfragmenting) form of radiation, stimulated desorption can cause fragmentation and also produce internally hot molecules which photofragment relatively easily compared to lower temperature sources of molecules. Typically, the low mass regions of the mass spectra contain a good deal of molecular fragment information.

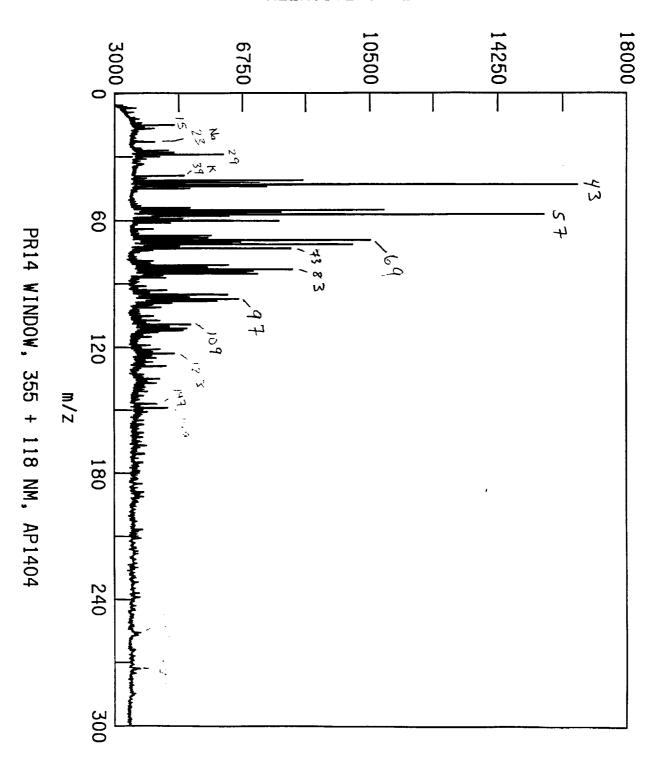
Some other comments on the mass spectra are appropriate. The signals from the microchannel plate detector were recorded in analog fashion by a 100 MHz transient digitizer; thus the voltage signals are given as "relative intensity" and not as ion counts. For the two windows with apparent yellowish contaminant films (PR14 and 17), higher desorption laser intensities were needed to provide substantial signals, indicating a less volatile contamination than for the two mirrors (or possibly poorer absorptivity of 355 nm light). For sample PR17, and a little bit for the control mirror (DMES 26-92), direct ion signals (intense and broad mass peaks on a different mass scale--different time zero) are seen in the low mass region.

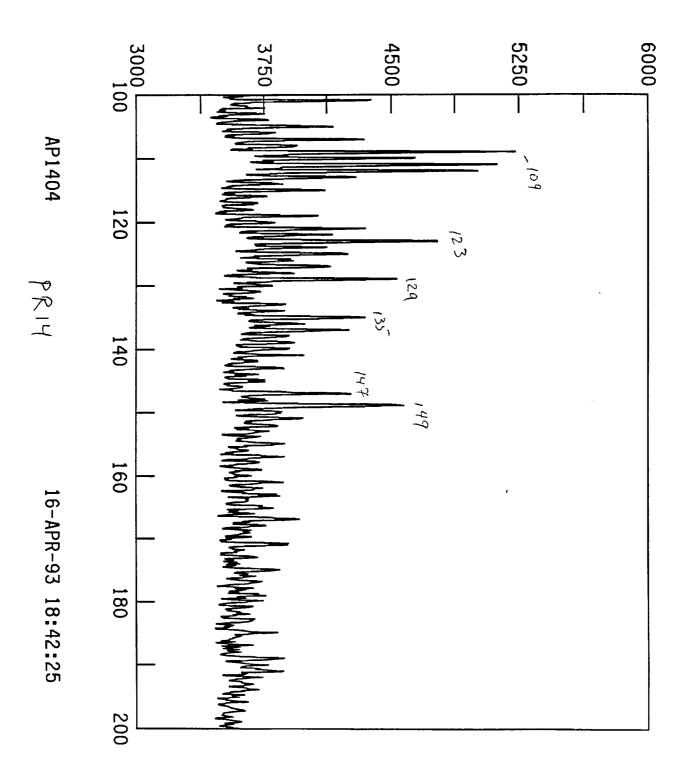
Some of the mass assignments have been marked on the figures, especially for the major peaks. Considerable effort can be invoked for mass interpretation. Some possible brief general interpretations now follow. Window PR14 and the 9-93 MgF2 mirror show considerably more hydrocarbon fragments at low masses and thus likely contain much more hydrocarbon components than the other two samples.

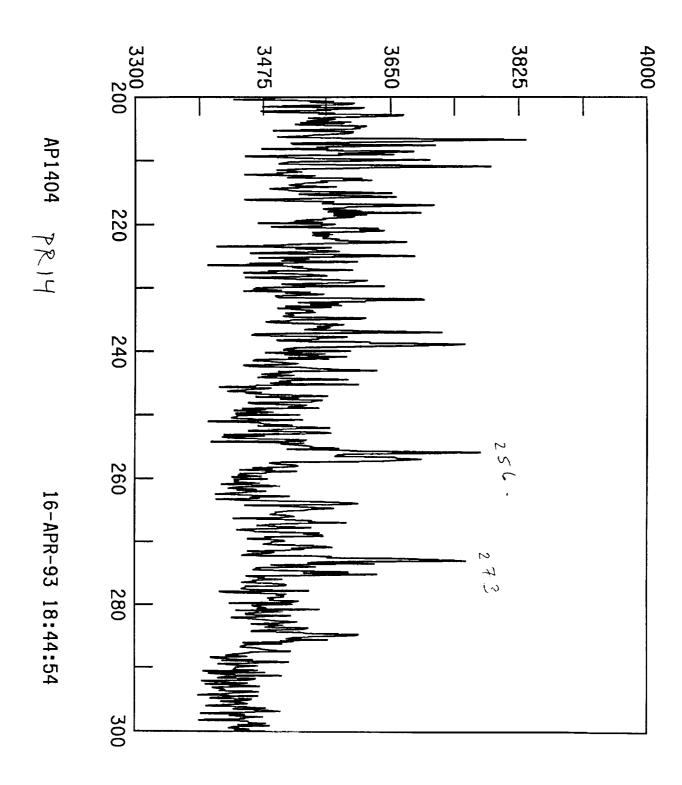
For PR17 the m/z 105 and 207 peaks can be associated with Si and O (Si2O3H for 105 and Si3O3(CH3)5 for 207), although there are other interpretations such as C6H5-CO for m/z 105. Also it would be unusual to observe a strong 207 and not a strong 73 or 147 for a silicone. Polydimethylsilicone was run as a standard for comparison under these conditions; strong peaks at m/z 73, 147, 207, 221, and 281 were observed.

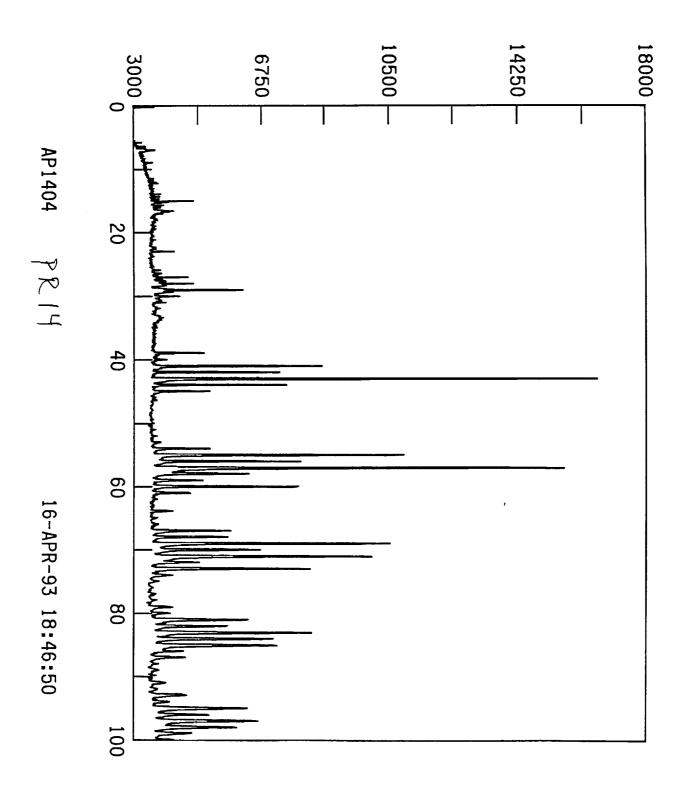
For the two MgF2 mirrors, there are numerous major mass peaks in common such as 43, 57, 97, 112, 149, 167. 185 and 221. Note that 221 can possibly be assigned to a silicone, but the other peaks are not commonly associated with silicones except m/z 129 in the 9-93 mirror which can be rationalized as a Si2C5H13 structure. Masses 97, 112, 149, 167, and 185 can be assigned to CxFyOz structures. As to the higher mass assignments for the control mirror, it is not clear (especially with no detailed knowledge of sample history) what structures are associated with these masses; however, these peaks will be very characteristic of whatever compound(s) is present.

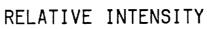


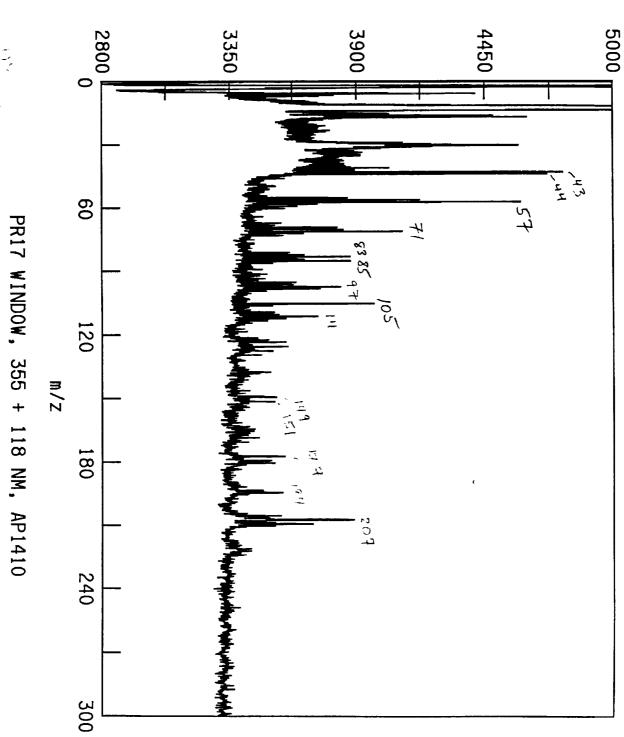


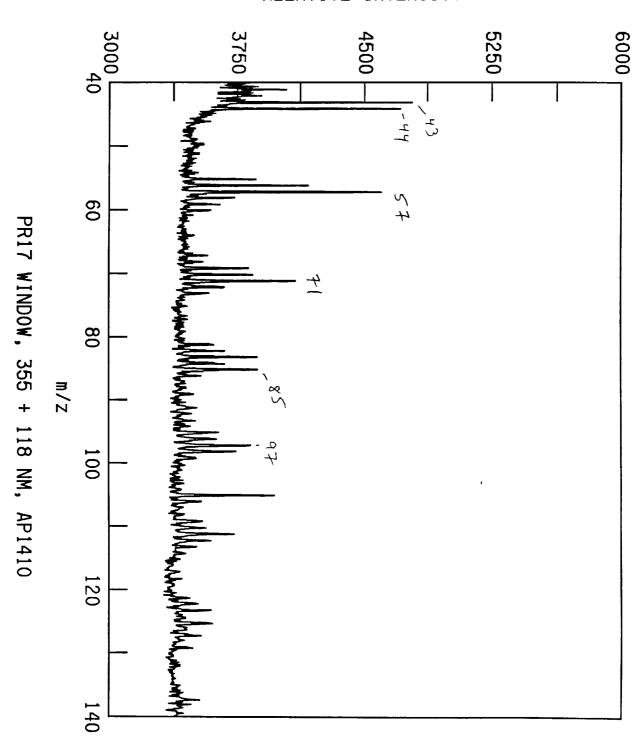


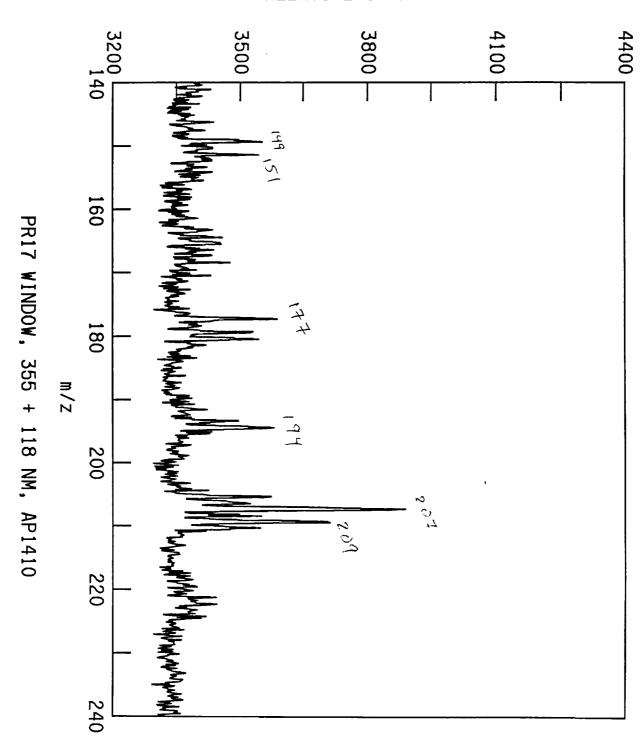


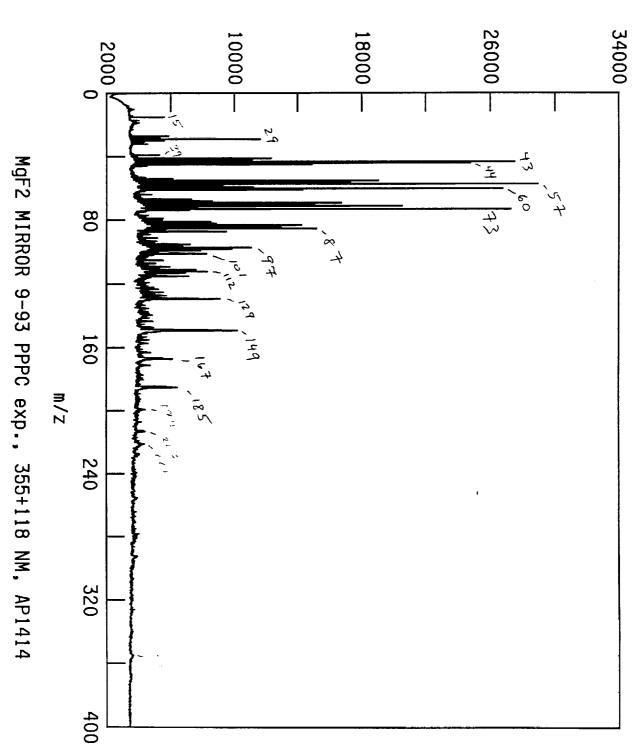


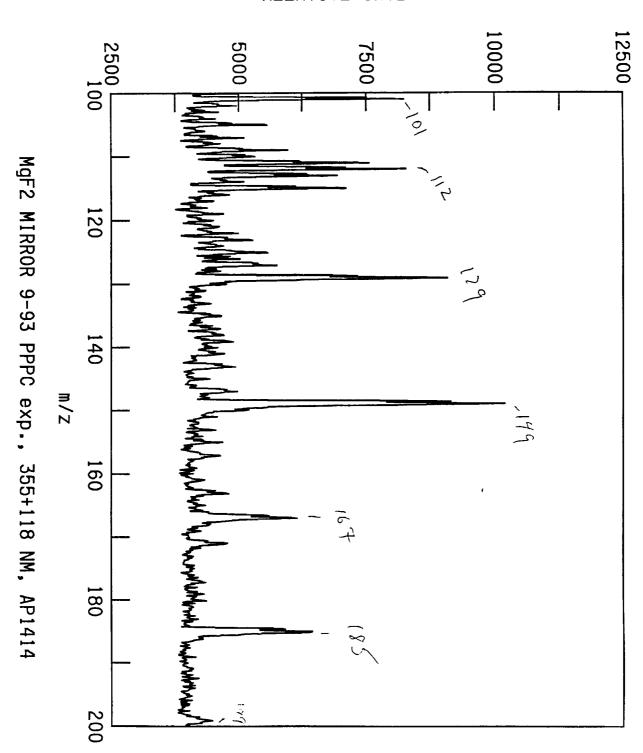


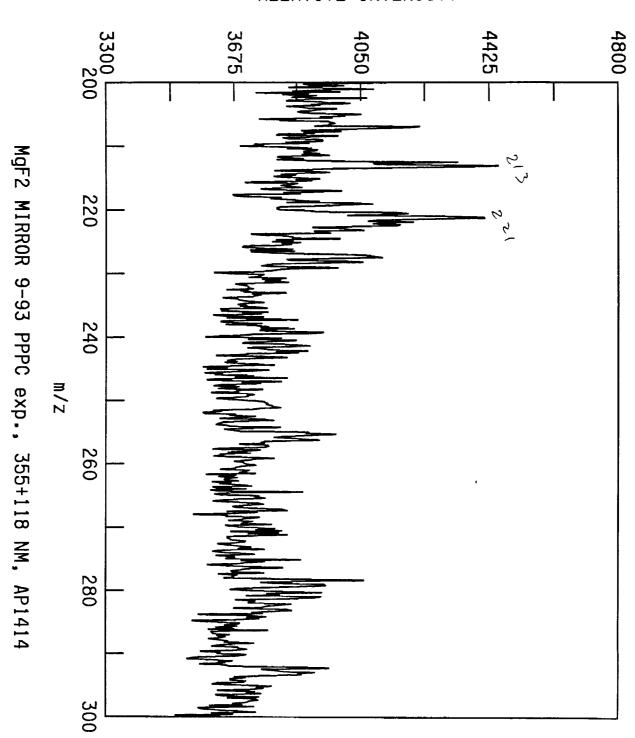


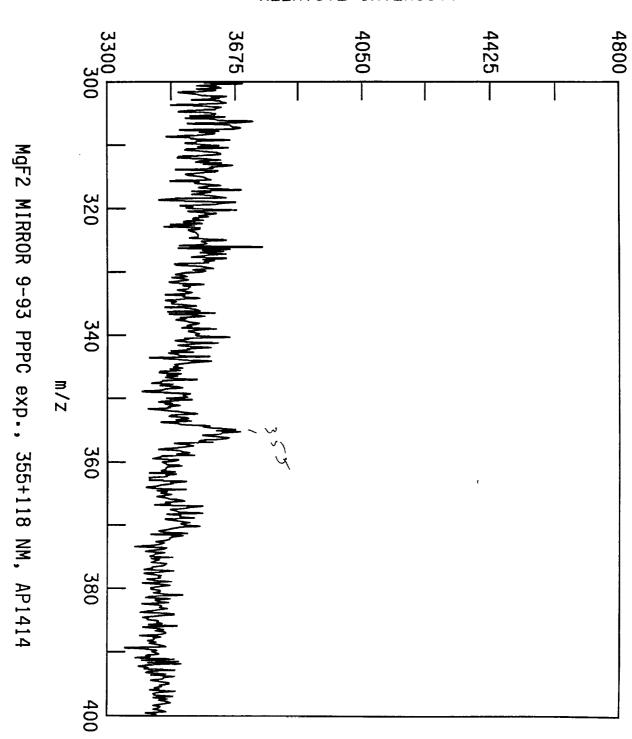


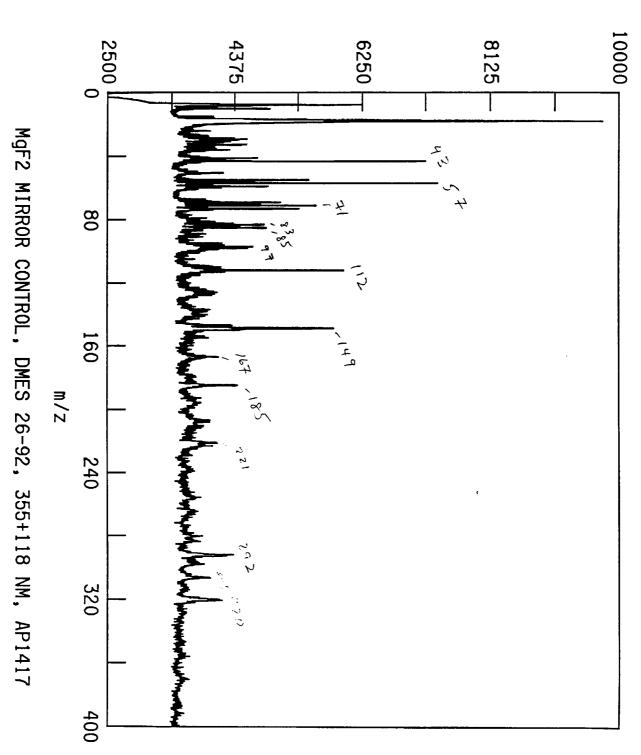


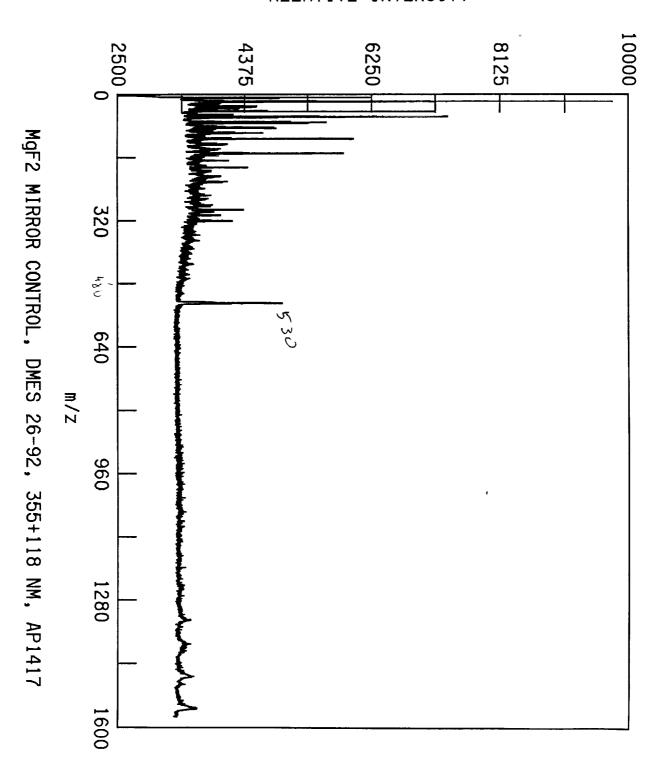


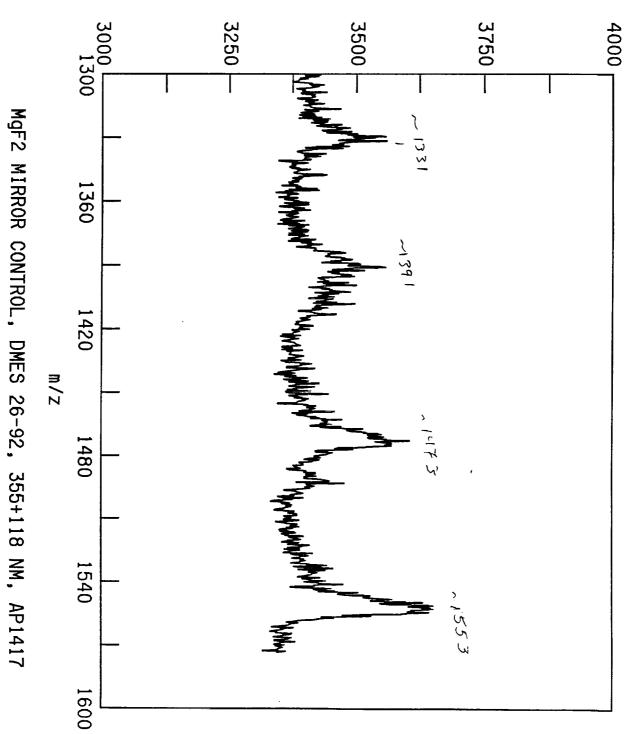












REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188			
Public reporting burden for this collection of information is estimated to everage 1 hour per response, including the time for reviewing instructions, searching existing data sources, gethering and mointaining the data needed, and completing and reviewing the collection of information. Send commissions reporting this burden estimates or any other deport of this sufficient of information including suggestions for reducing this burden, see Washington Needquarrent Services, Directorate for Information Operations and Reports, 1216 Jefferson Dwide Highwey, Suites 1206, Artington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Weehington, DC 20603.								
1. AGENCY USE ONLY (Leave blank	_	2. REPORT DATE	3. REPORT TYPE AND					
		April 1993	Final Report					
4. TITLE AND SUBTITLE REPORT ON CHEMICAL ANALYSES OF PROVIDED SAMPLES				6. FUNDI	NG NUMBERS			
				ĺ	0. H-07967D			
6. AUTHOR(S) Christopher H. Becker					V.D. H-0 11612			
7. PERFORMING ORGANIZATION I	NAME	(S) AND ADDRESS(ES)			RMING ORGANIZATION			
SRI International				PYU				
333 Ravenswood Avenu	ıe				3-084			
Menlo Park, CA 9402	25	•]			
9. SPONSORING/MONITORING A	GENC	Y NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING				
NASA Marshall Space	Fli	ght Center		AGE	NCY REPORT NUMBER			
Huntsville, AL 3581	12							
	,			ļ				
11. SUPPLEMENTARY NOTES				·				
12a. DISTRIBUTION/AVAILABILIT	V STA	TENENT		12b. DIS	TRIBUTION CODE			
Approved for public	-		is unlimited	120				
ubbrosed for bastro		6036, 010011	10 0					
				<u> </u>				
13. ABSTRACT (Maximum 200 wo	NGS)							
A batch of four samples	wei	re received and chemica	l analysis was perf	ormed o	f the surface and near			
surface regions of the same	ples i	by the surface analysis b	by laser ionization	(SALI) r	nethod. The samples			
included four one-inch diau	mete	r optics labeled window	s # PR 14 and PR 1	7 and M	gF2 mirrors 9-93 PPPC			
included four one-inch diameter optics labeled windows # PR14 and PR17 and MgF2 mirrors 9-93 PPPC exp. and control DMES 26-92. The analyses emphasized surface contamination or modification. In these								
studies, pulsed desorption by 355 nm laser light and single-photon ionization (SPI) above the sample by								
coherent 118 nm radiation (at ~5 x 105 W/cm2) were used, emphasizing organic analysis.								
way								
For the two windows with an apparent yellowish contaminant film, higher desorption laser power was								
needed to provide substantial signals, indicating a less volatile contamination than for the two mirrors.								
Window PR 14 and the 9-93 mirror showed more hydrocarbon components than the other two samples. The mass spectra, which show considerable complexity, are discussed in terms of various potential								
chemical assignments.								
14. SUBJECT TERMS					15. NUMBER OF PAGES			
EDEF, surface analysis, surface contamination,					17 16. PRICE CODE			
space environmental effects					16. PRICE CODE			
17. SECURITY CLASSIFICATION	18	SECURITY CLASSIFICATION	19. SECURITY CLASSI	ICATION	20. LIMITATION OF			
OF REPORT		OF THIS PAGE	OF ABSTRACT		ABSTRACT			
Unclassified		Unclassified	Unclassifi	ed	UL			